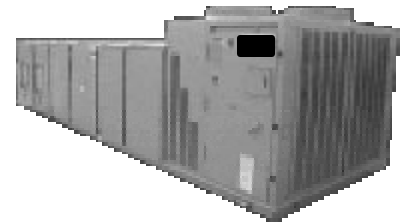
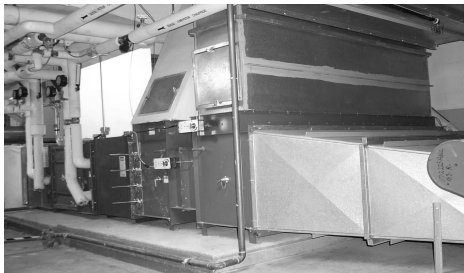




ASHRAE, Anaheim, US, January 2003

EMCS Assisted Commissioning Tool For Variable Air System



[Http://lrdec.mets.rncan.gc.ca](http://lrdec.mets.rncan.gc.ca)

Daniel Choinière ing., 450-652-4874

dchoinie@nrcan.gc.ca



Ressources naturelles
Canada

Natural Resources
Canada

CETC/CTEC - Varennes 

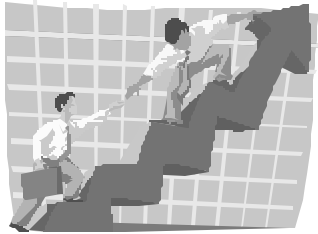
Canadian Contribution:

- IEA Annex 40, Commissioning of Building HVAC Systems for Improved Energy Performance
- IEA Annex 34, Computer-aided Evaluation of HVAC System Performance: the Practical Application of Fault Detection and Diagnosis Techniques in Real Buildings
- Acknowledgements: PERD, Natural Resources Canada

WHY?

Commissioning, Re, On Going-Commissioning, Energy Management

- 15-30% energy savings
- Improve comfort
- Facilitate maintenance
- Continuity in energy savings measures
- Extend HVAC equipment life

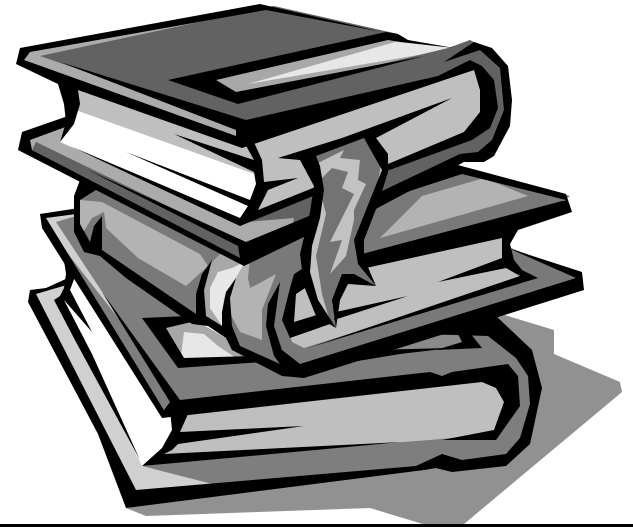


Outline

- EMCS Assisted Cx Tool
- Methods
- Results
- Next steps

Definitions

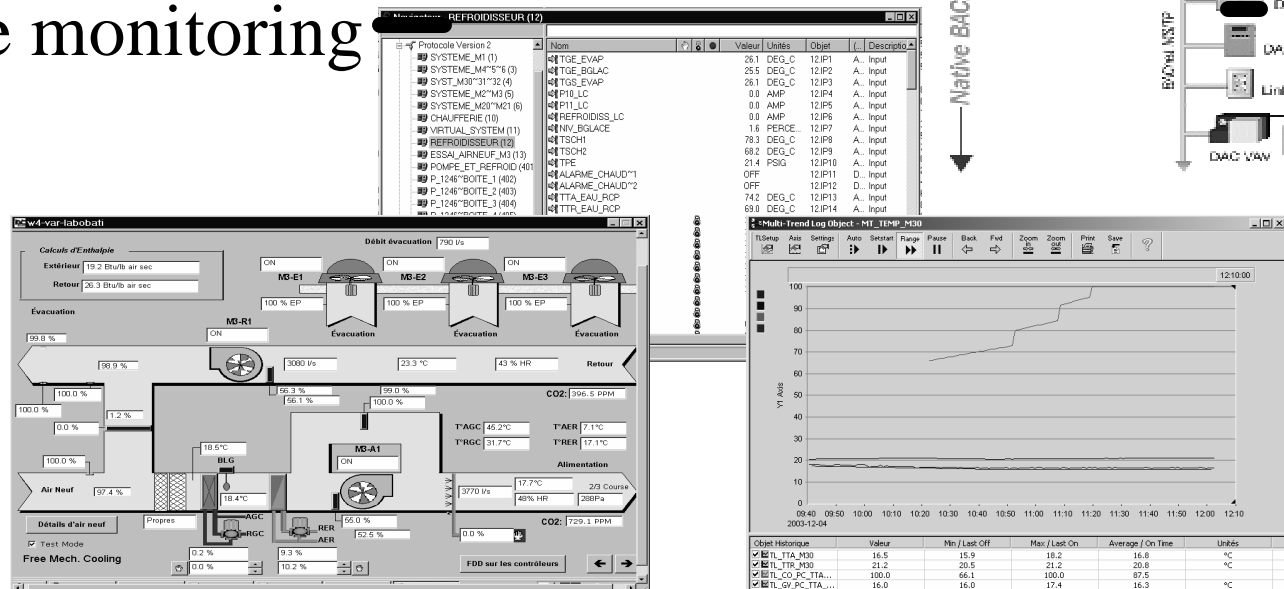
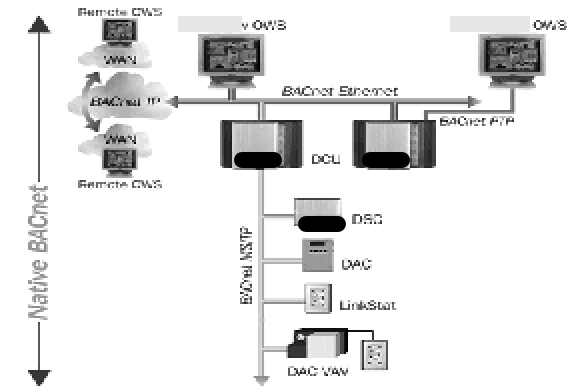
- On-going Commissioning Tool



- Detect unsatisfactory performance and diagnose faults
- Function of installed equipments and occupation type:
 - ◆ Optimize energy use, while maintaining or improving occupant comfort and productivity;

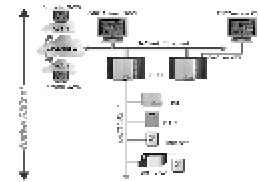
EMCS Today

- Good to control system
- Good to allow visualization in real time (if graphics are well configured)
- Manage simple alarms
- Simple monitoring





Energy Management and Control System Building-Plants-Systems-Rooms



Feedback To EMCS

DABO TOOL
Commissioning
+ DATABASE

FDD VAV, AHU,
Rooftop, H&C networks

FDD
Systems level

ENERGY AUDITING

REPORT GENERATOR

Component level:

- Defective devices

System level:

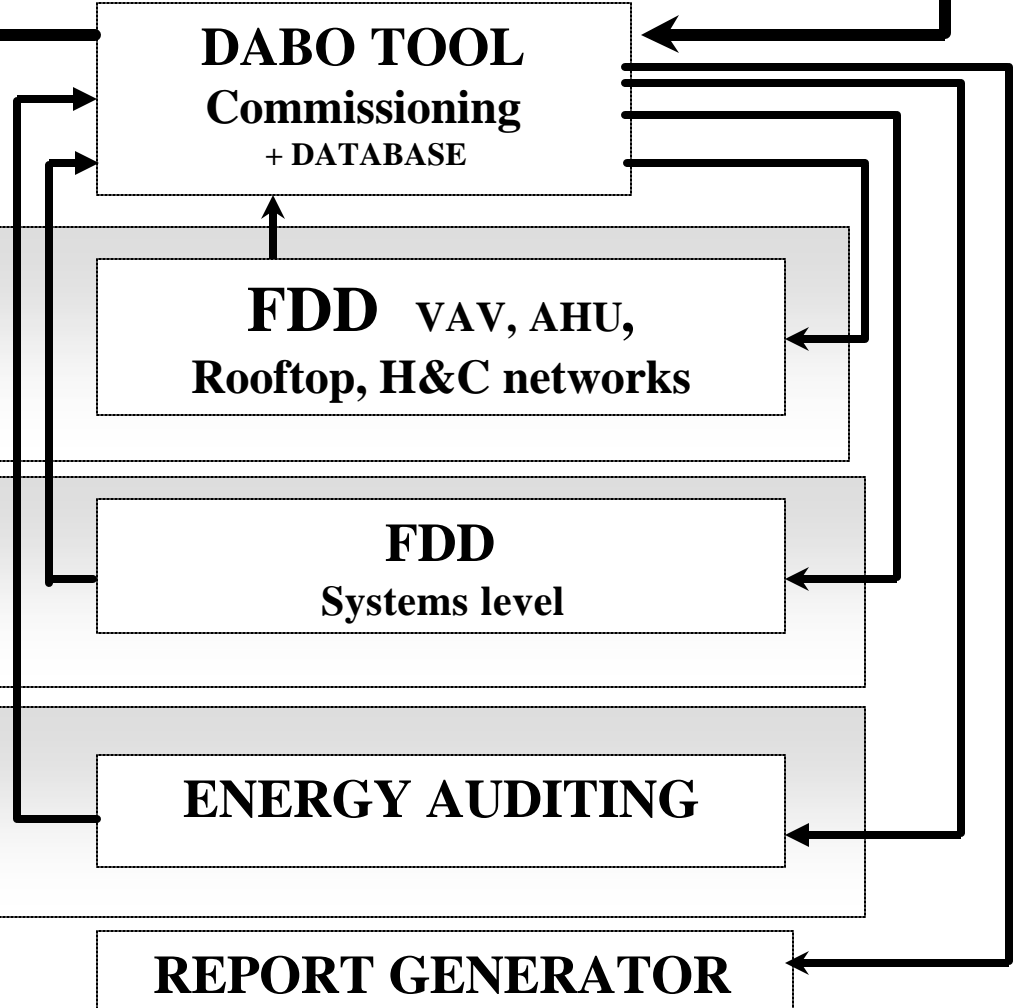
- Optimisation: setpoint and sequence of operation

Global analysis:

Energy efficiency projects

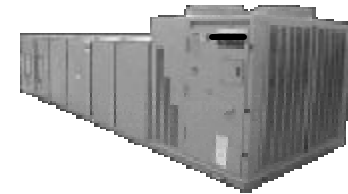
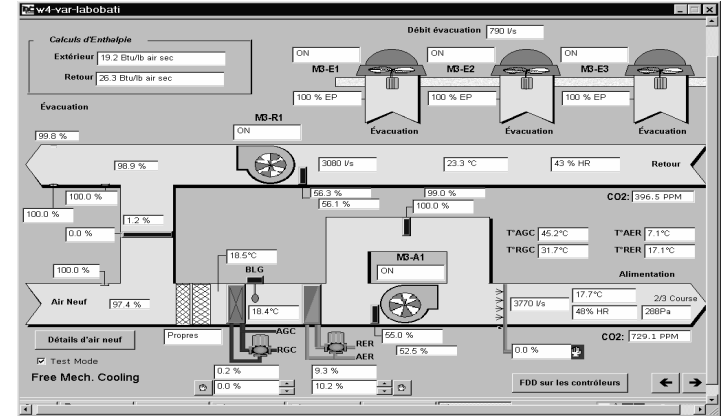
Operator, Energy manager

Artificial Intelligence Tech.



Fault Detection and Diagnosis: Component Level

- Sensor (temperature, humidity, air flow, pressure, CO₂, current)
 - ◆ incorrect reading, complete failure
- Damper, valve, actuator
 - ◆ stuck, position, minimum, leakage
- Coil, humidifier, fan
 - ◆ undercapacity
- Controller
 - ◆ logic, tuning, signal, unstable (setpoint, output)
- Point in manual



Fault Detection and Diagnosis: System Level



■ Detection of:

- ◆ under or over design components, systems and plants
- ◆ Non optimum set points
 - Temperature, pressure, humidity, ventilation, start-up time
- ◆ Inappropriate sequence of operation
- ◆ Poor energy management and peak load control

Energy Auditing

- Energy profile (Day, month and year)
 - Equipment level (TERMINAL, AHU, Power plant)
 - Building level (electric, gas, oil meter?)
 - Include adjustment and influence factors
- ◆ Monitoring of energy saving measures
- ◆ Historical database for energy audit or retrofit
- ◆ Real time energy audit
- ◆ Link to accounting manager software
- ◆ FDD at building level (Tariffs, reference profile)

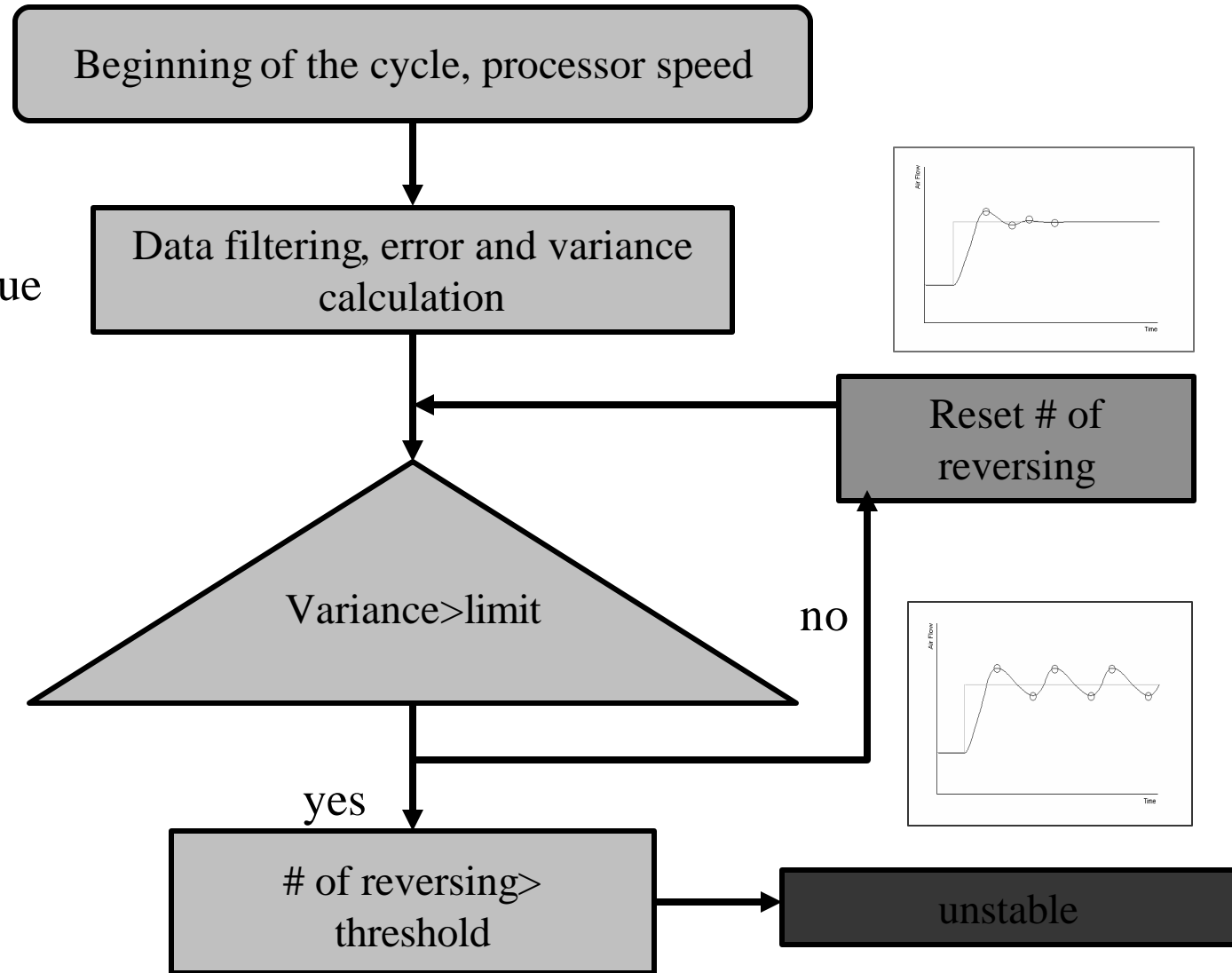
Embedded Steady State Detector

■ Inputs:

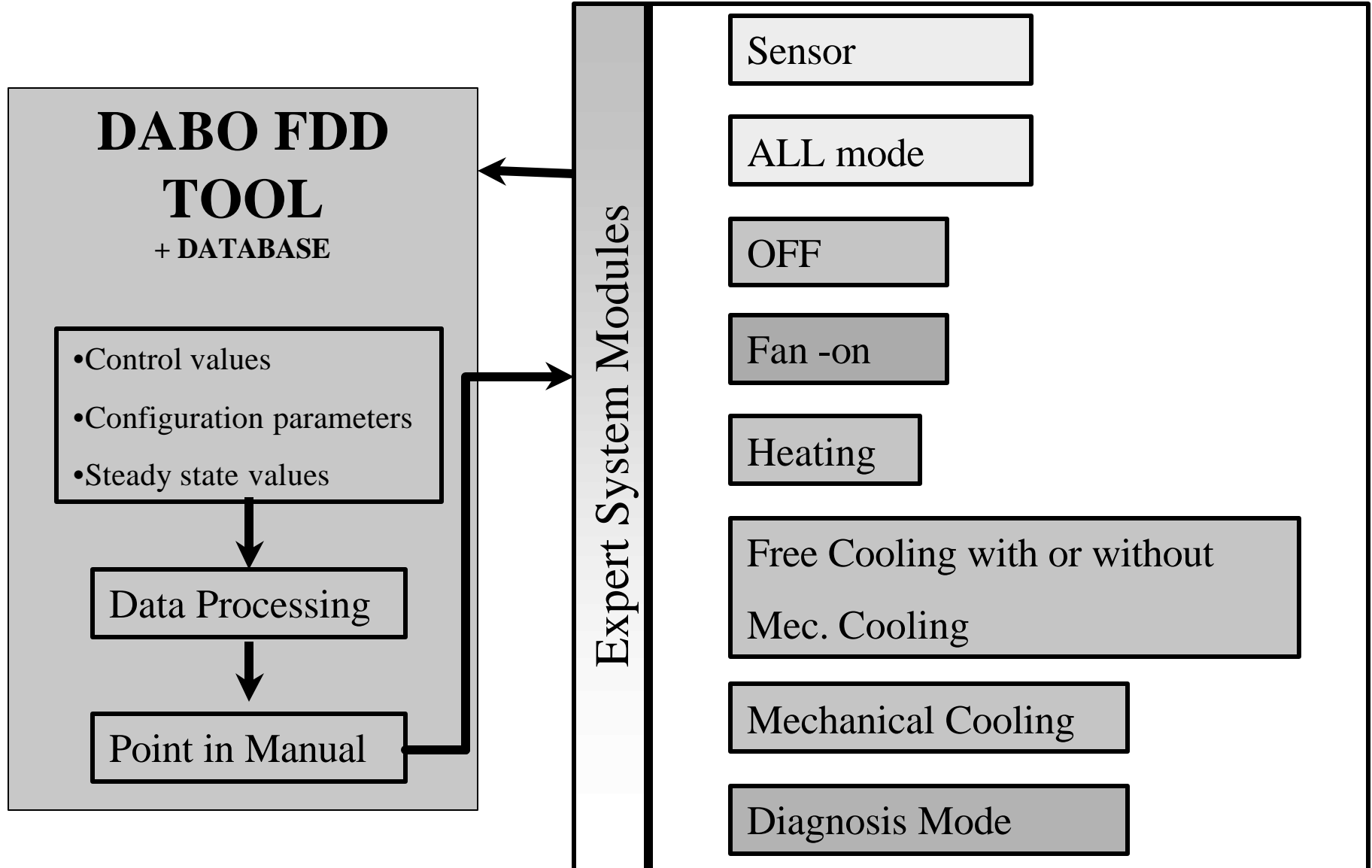
- ◆ Setpoint and value
- ◆ Control output and bias

■ Configuration inputs

- ◆ Filtering rate
- ◆ Variance limit
- ◆ Threshold # of reversing



FDD Architecture, Component Level



Fault Detection and Diagnosis: System Level

- Indice of performance:
 - ◆ With existing control points, find an equation that:
 - Characterize devices condition
 - Characterize devices utilisation
 - **Allow comparison between devices**

✧ Utilisation factor ✧

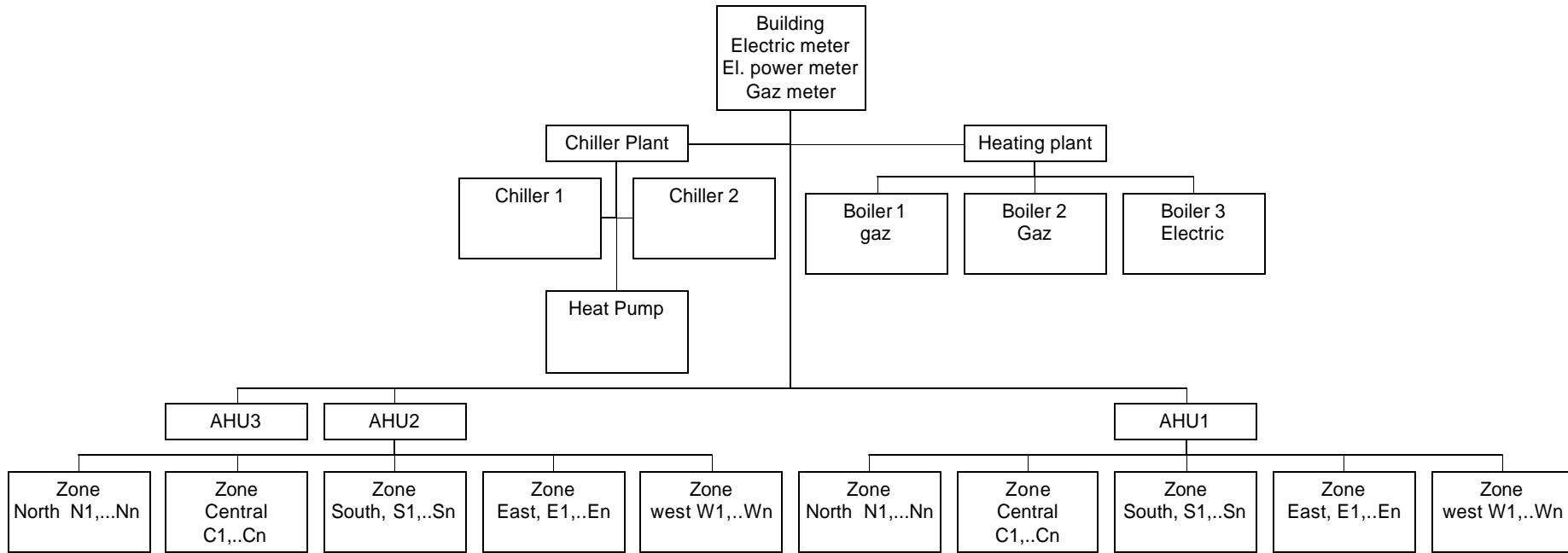
- Method:
 - ◆ Analysis of Utilisation Factors
 - ◆ Diagnosis method: Statistics and Rule base

Performance indice: Room Level

Indice	Optimisation, performance report	Detection,
<i>Temperature (%)</i>		<p>Under and overdesign components</p> <p>Poor sequence of operation</p>
<i>Air quality (%)</i>	% of fresh air	
<i>Damper position (%)</i>	SAP	
<i>Cooling (%)</i>	SAT, SAP	
<i>Heating (%)</i>	SHWT	
<i>Reheating (%)</i>	SHWT	
<i>Airflow (%)</i>	SAP, SAT	
<i>Fault Code</i>		
<i>Fault type</i>	Confort, energy, life cycle	

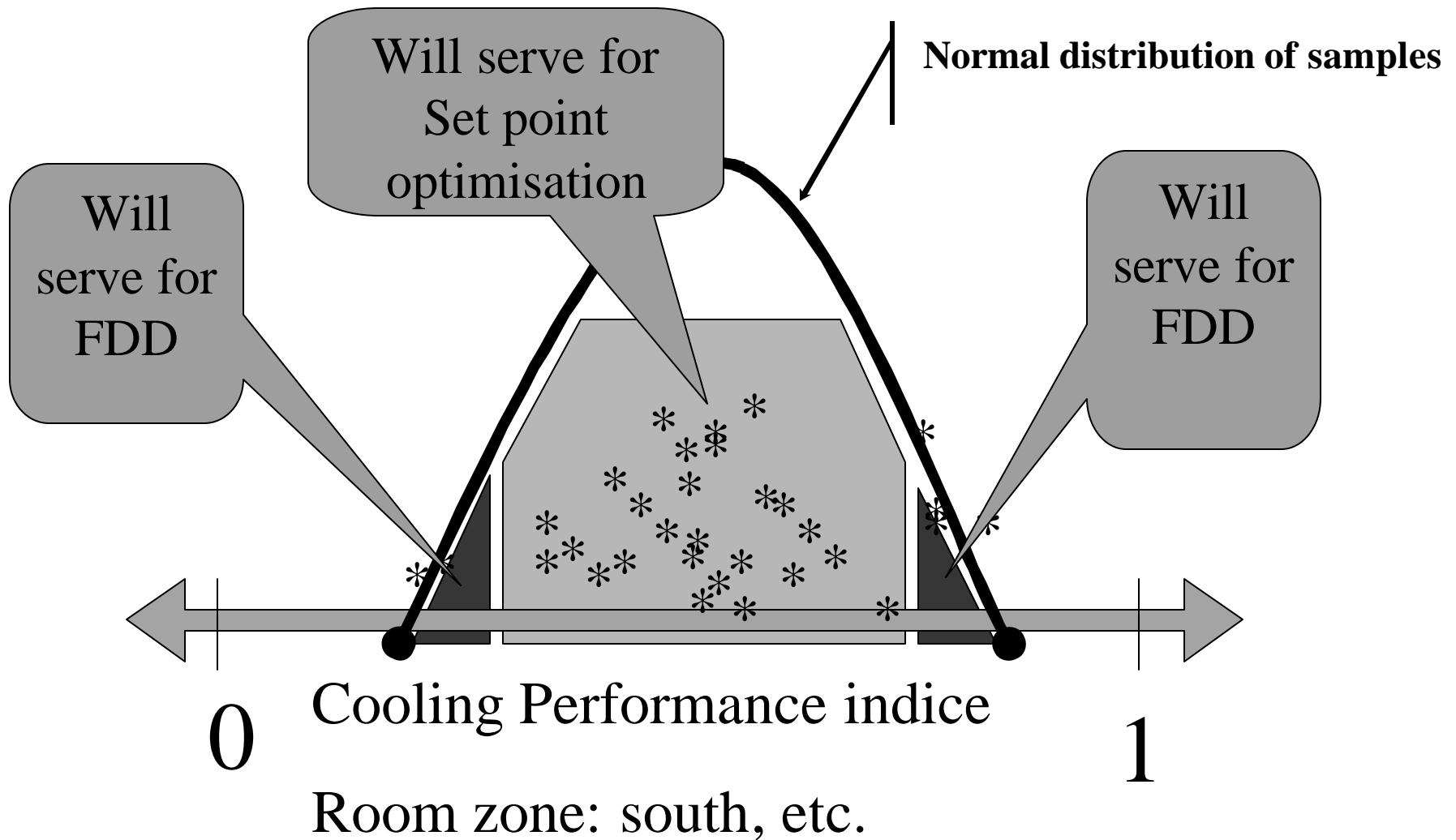
Performance indice: Utilisation Factors, System level

- Supply, return Fan indice (vsd%)
- Airflow (airflow)
- Heating coil indice (%HC, Time on)
- Cooling coil indice (%CC, Time on)
- Reheat coil indice (%RHC, Time on)
- Humidifier indice (%HUM, Time on)
- Fresh air indice (% , calculation)
- Cooling indice
- Heating indice



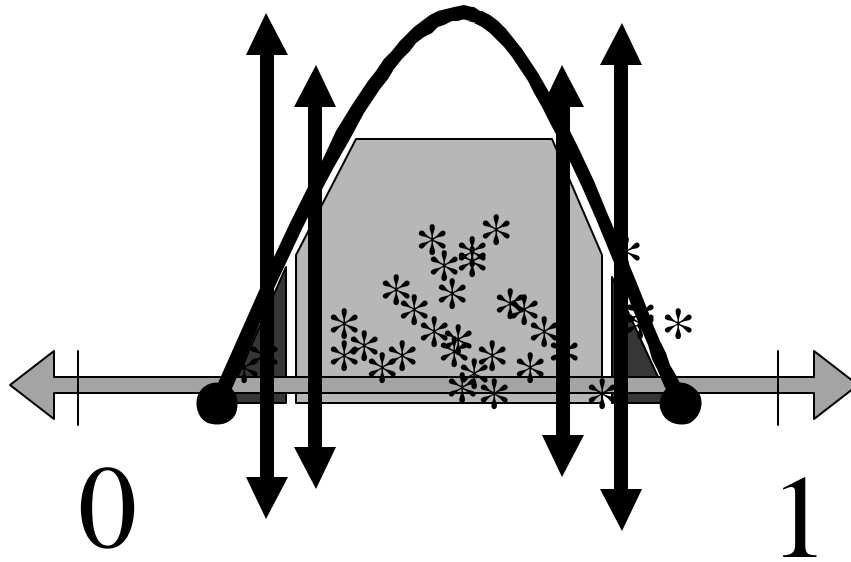
U.F analysis: real time, 1H, 1 working period etc..

- Between rooms in a same zone and AHU
- Between AHUs components (CC, HC)
- Between Chillers, Boilers



- Sort by Statistic methods, filters, etc
- Depend, # and type of samples

Calculation of Warning and Critical Limit Parameters, Reference Pattern

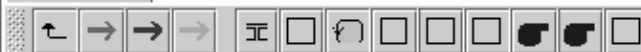


- Could be constant or dynamic
- User define
- User define with DABO tool
- Calculate by DABO (Statistic, clustering method, etc.)

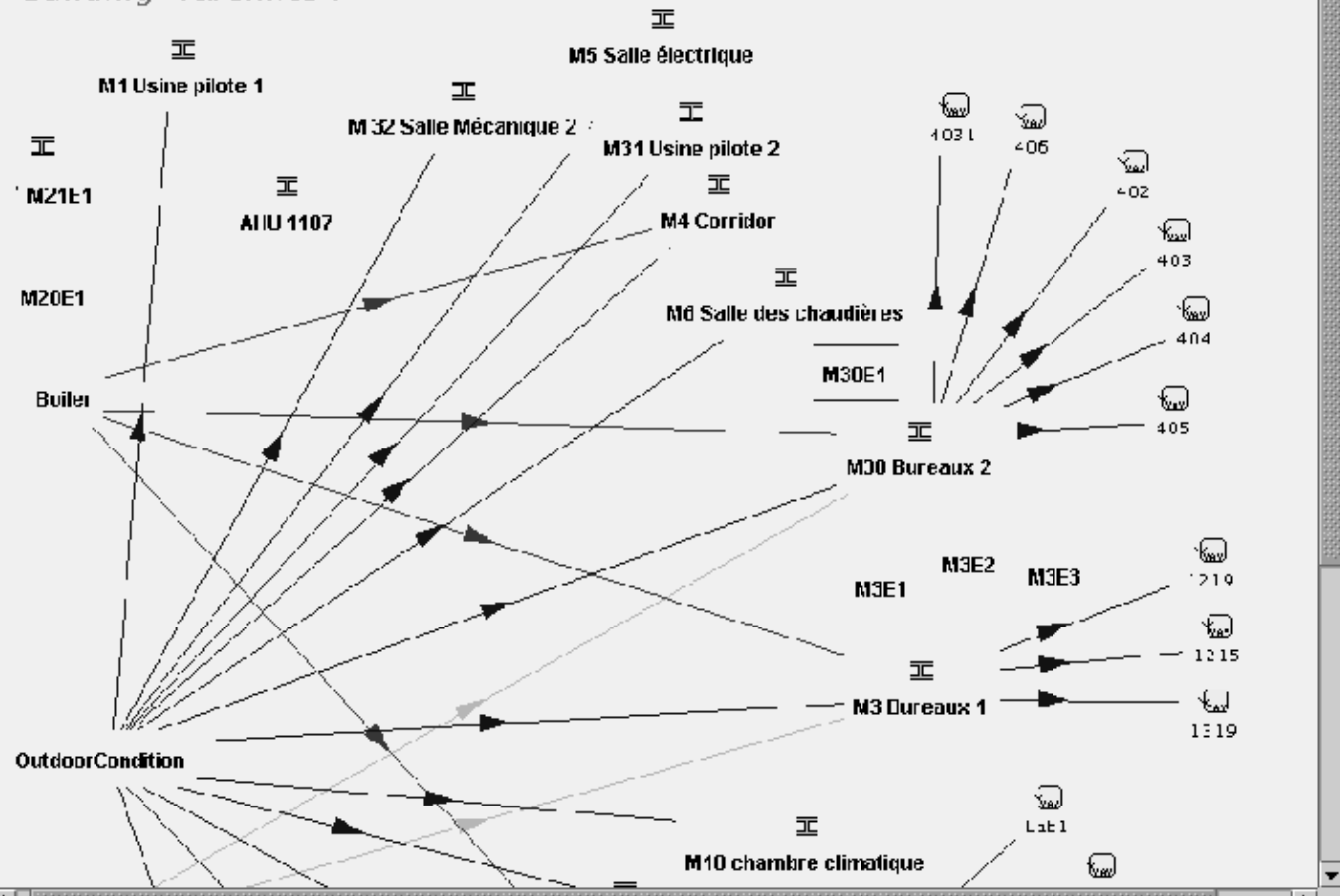
- Filter option in statistic calculation :
 - ◆ Devices (one or all)
 - ◆ Date
 - ◆ Hour
 - ◆ Outside air temperature
 - ◆ Outside air humidity
 - ◆ Solar (if sensor is available)

- BAS
 - Building-Varennes
 - OutdoorCondition
 - M3C Bureaux 2
 - 406
 - 402
 - 403
 - 404
 - 405
 - M3 Bureaux 1
 - FreshAirSection
 - CoilAirSection
 - SupplyAirSection
 - AirFilter
 - Humidifier
 - Temperature
 - AirFlow
 - Humidity
 - CO2
 - Pressure
 - links
 - ReturnAirSection
 - MixedAirSection
 - ExhaustAirSection
 - SupplyFan
 - ReturnFan
 - ExternTemperature
 - links
 - 1215
 - 1219
 - 1319
 - M2 Laboratoires
 - Lab1
 - Lab6

Graphic View



Building-Varennes :



Diagnostic Agent for

M3 Bureaux 1 Properties Configuration									
View	Thresholds - controller	Thresholds - sensors	Sensor Modul	General settings	Operating modes	Fans	Points Setting	FDD_AHU_CS_H	
Point name				Address	Units				
BAS_Building-Varennes_M3 Bureau 1	SupplyAirSection_AirFlow_Status	GV_DEBIT_M3_A1	V2.13.GV56	L/s					
BAS_Building-Varennes_M3 Bureau 1	SupplyAirSection_AirFlow_SPStability								
BAS_Building-Varennes_M3 Bureau 1	SupplyAirSection_Humidity_SetPoint								
BAS_Building-Varennes_M3 Bureau 1	SupplyAirSection_Temperature_Status	THA_M3	V2.13.IP14	%					
BAS_Building-Varennes_M3 Bureau 1	SupplyAirSection_Humidity_SPStability								
BAS_Building-Varennes_M3 Bureau 1	SupplyAirSection_CO2_SetPoint	GV_ACCEPTABL_CO2	V2.13.GV29	PPM					
BAS_Building-Varennes_M3 Bureau 1	SupplyAirSection_CO2_Status	CO2_SUPPLY_M3	V2.13.IP6	PPM					
BAS_Building-Varennes_M3 Bureau 1	SupplyAirSection_Pressure_SetPoint	GV_FC_PTCDI_M3	V2.13.GV16	Pa					
BAS_Building-Varennes_M3 Bureau 1	SupplyAirSection_Pressure_Status	TPDI_M3	V2.13.IP25	Pa					
BAS_Building-Varennes_M3 Bureau 1	SupplyAirSection_Pressure_SPStability	F_IN_COS_TPD_M3	V2.13.GV64	8IN					
BAS_Building-Varennes_M3 Bureau 1	ReturnAirSection_Temperature_SetPoint								
BAS_Building-Varennes_M3 Bureau 1	ReturnAirSection_Temperature_Status	TTR_M3	V2.13.IP15	°C					
BAS_Building-Varennes_M3 Bureau 1	ReturnAirSection_Temperature_SPStability								
BAS_Building-Varennes_M3 Bureau 1	ReturnAirSection_AirFlow_SetPoint	GV_PC_SDR_M3	V2.13.GV23	Pa					
BAS_Building-Varennes_M3 Bureau 1	ReturnAirSection_AirFlow_Status	GV_DEBIT_M3_R1	V2.13.GV57	L/s					
BAS_Building-Varennes_M3 Bureau 1	ReturnAirSection_AirFlow_SPStability	F_INS_SDR_M3	V2.13.GV87	8IN					
BAS_Building-Varennes_M3 Bureau 1	ReturnAirSection_Humidity_SetPoint	GV_PC_THR_M3	V2.13.GV53	%					
BAS_Building-Varennes_M3 Bureau 1	ReturnAirSection_Humidity_Status	THR_M3	V2.13.IP16						
BAS_Building-Varennes_M3 Bureau 1	ReturnAirSection_Humidity_SPStability	F_IN_COS_THR_M3	V2.13.GV90	8IN					
BAS_Building-Varennes_M3 Bureau 1	ReturnAirSection_CO2_SetPoint	GV_ACCEPTABL_CO2	V2.13.GV29	PPM					
BAS_Building-Varennes_M3 Bureau 1	ReturnAirSection_CO2_Status	CO2_RETURN_M3	V2.13.IP5	PPM					
BAS_Building-Varennes_M3 Bureau 1	ReturnAirSection_Enthalpy_SetPoint								
BAS_Building-Varennes_M3 Bureau 1	ReturnAirSection_Enthalpy_Status	GV_AHU_M3_RAE V2.13.GV411		KJ/kg					
BAS_Building-Varennes_M3 Bureau 1	MixedAirSection_Damper_CommandPoint	MIX_AIR_DAMP_M3	V2.13.OP4	%					
BAS_Building-Varennes_M3 Bureau 1	MixedAirSection_Damper_Status	POS_MIX_AIR_DAMP V2.13.IB20	1						
BAS_Building-Varennes_M3 Bureau 1	MixedAirSection_FlowRate_SetPoint	F_INST_FC_M3	V2.13.GV25	8IN					
BAS_Building-Varennes_M3 Bureau 1	MixedAirSection_Temperature_SetPoint								
BAS_Building-Varennes_M3 Bureau 1	MixedAirSection_Temperature_Status	TTM_M3	V2.13.IP8	°C					
BAS_Building-Varennes_M3 Bureau 1	MixedAirSection_Temperature_SPStability								
BAS_Building-Varennes_M3 Bureau 1	MixedAirSection_Temperature_Stability								
BAS_Building-Varennes_M3 Bureau 1	ExhaustAirSection_Damper_CommandPoint	MOD_EX_DAMP_M3	V2.13.OP3	%					

M3 Bureau 1 Properties Configuration

View

Thresholds - controller

Thresholds - sensors

Sensor Modul

General settings

Operating modes

Fans

Points Setting

FDD_AHU_CS_H

Fan

min. flow

max. flow

min. ampere (A)

max. ampere (A)

Supply Fan

200.0

5000.0

10.0

21.3

Return Fan

100.0

2000.0

1.0

3.5

Differential supply/return airflow

80.0

L/s

Maximum supply air static pressure setpoint

275.0

Pa

Minimum supply air static pressure setpoint

150.0

Pa

Threshold SAPSP/SAPS

50.0

Pa

Minimum fresh air flow

800.0

L/s

Threshold outside air flow

100.0

L/s

Threshold supply-return airflow

75.0

L/s

Maximum pressure drop across filter

100.0

Pa

Minimum pressure drop across filter

50.0

Pa

Threshold SFV,RV and SFVS,RVVS

5.0

%

Print

OK

Cancel

M3 Bureaux 1 Properties Configuration

View
Thresholds - controller
Thresholds - sensors
Sensor Model
General settings
Operating modes
Fans
Points Setting
FDD_AHU_CS_H

Temperature rise across supply fan
1.5
°C

Temperature rise across return fan
0.5
°C

Supply air temperature set point reasonable value

heating mode
17.0
to
21.0
°C

free cooling & cooling mode
13.0
to
19.0
°C

Zone air temperature set point reasonable value

18.0
to
26.0
°C

Fresh air damper at min. position
0.0
%

Mixed air damper position at minimum fresh air
100.0
%

Percentage of fresh air at minimum
15.0
%

Return air humidity set point reasonable vale
35.0
%

Design winter outdoor air temperature
-28.0
°C

Design summer outdoor air temperature
34.0
°C

Winter night freeze protection shout off
5.0
°C

Without cooling device, OAT limit to satisfy ZATSP or SATSP
0.0
°C

Minimum return air temperature sensor
18.0

Print
OK
Cancel

M3 Bureaux 1 Properties Configuration

View

Thresholds - controller

Thresholds - sensors

Sensor Model

General Settings

Operating modes

Fans

Points Setting

RDD_AHU_CS_H

Last service execution
Date/time of the last service execution
2003-09-19 07:53:04.838

Execution mode

☒ Manual

GO

☐ Automatic

Execution rate

☐ Daily

☐ Hourly

Execution time

From

17 / 07 / 2003 ... 09 : 53 AM

To

17 / 07 / 2003 ... 13 : 53 AM

Print

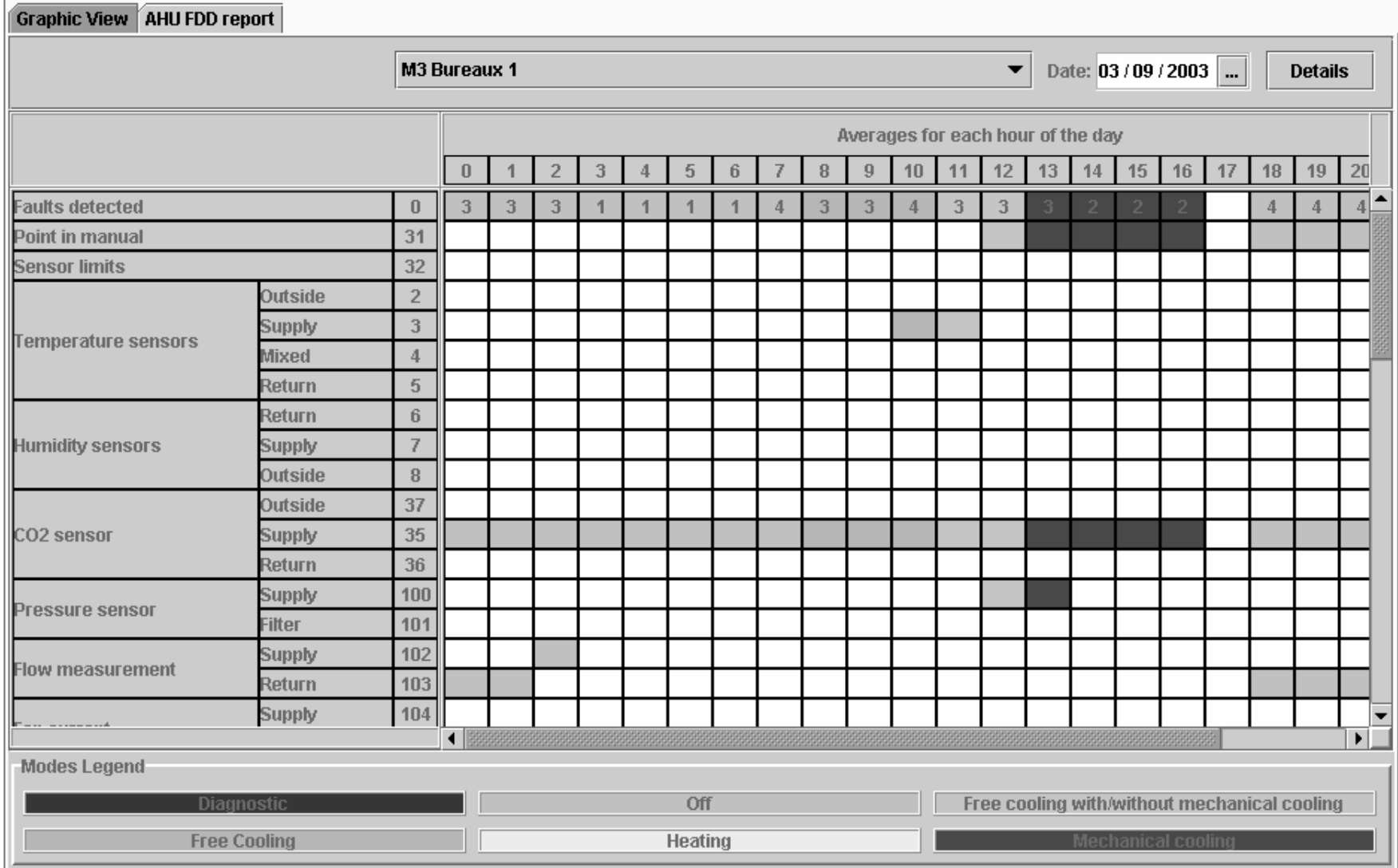
OK

Cancel

Demonstration Projects



FDD report for AHU



MAT uncalibrated by – 3°C

M30 Bureaux 2 - 2003-09-25 at 15h

Fault 3: Supply air temperature sensor

Mode: Free cooling with/without mechanical cooling

Suggested action: Verify calibration of temperature sensor

Impact: Possibility of overcooled or overheated air temperature causing room temperature control and increased terminal reheat if applicable

Rule 88: The supply air temperature is higher then the mixed air temperature and cooling coil valve is open

Fault 4: Temperature Sensors: Mixed

Mode: Free cooling with/without mechanical cooling

Suggested action: Verify calibration of temperature sensor or too much air stratification

Impact: Provide incorrect supply air temperature during free cooling and system shut down as a freeze stat protection

Rule 09: The supply air temperature is higher then the mixed air temperature and cooling coil valve is open

Rule 95: The outdoor air temperature is not equal to the mixed air temperature when the mixed air damper is fully open

Fault 5: Return air temperature sensor

Mode: Free cooling with/without mechanical cooling

Suggested action: Verify calibration of temperature sensor

Impact: Misrepresentation of zone temperatures leading to improper temperature of supply air set point

Rule 91: The return air temperature is lower then the allowable minimum return air temperature during free cooling

Fault 13: Mixed air damper failure

Mode: Free cooling with/without mechanical cooling

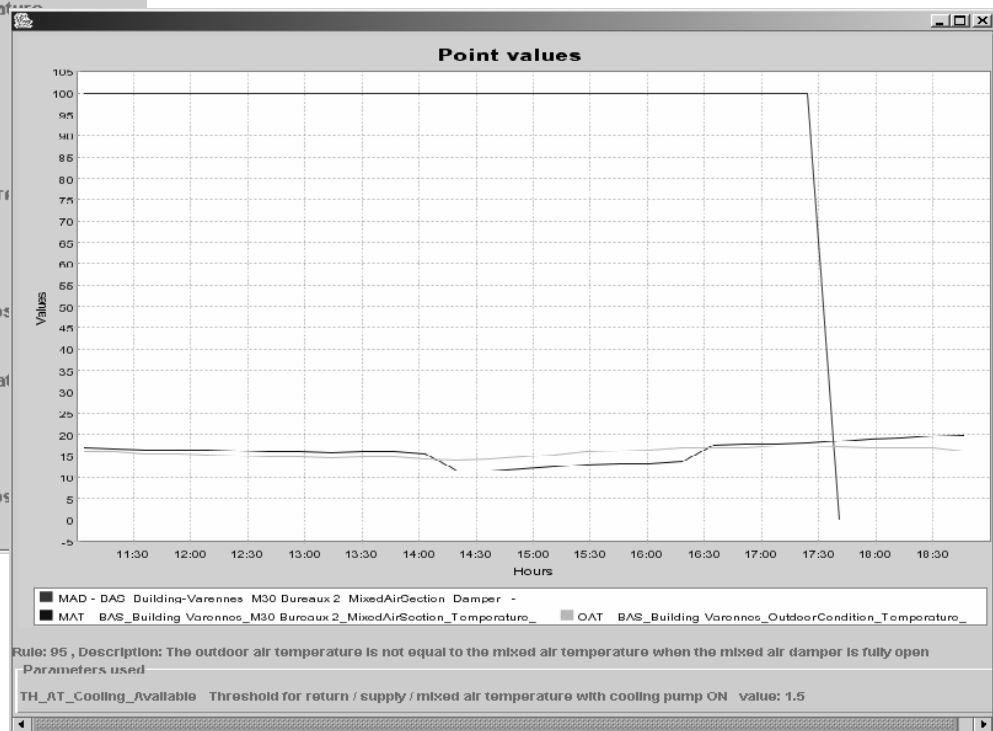
Suggested action: Verify damper, linkage, actuator, adjustment and leakage when closed up if stuck closed

Rule 95: The outdoor air temperature is not equal to the mixed air temperature when the mixed air damper is fully open

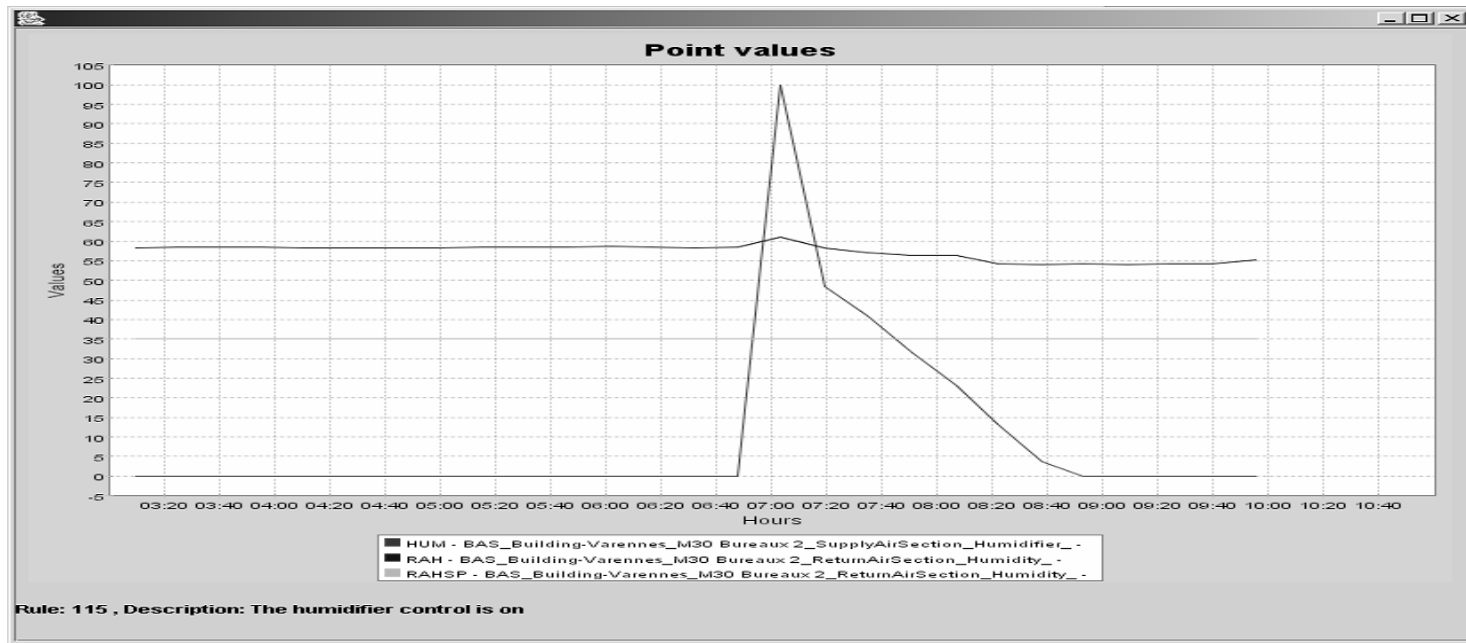
Fault 14: Outdoor air damper failure

Mode: Free cooling with/without mechanical cooling

Suggested action: Verify damper, linkage, actuator, adjustment and leakage when closed up if stuck closed



AHU-Fault: Wrong Humidifier Command



AHU fault details

M30 Bureaux 2 - 2003-08-13 at 8h

Fault 19: Control software problem

Mode: Mechanical cooling

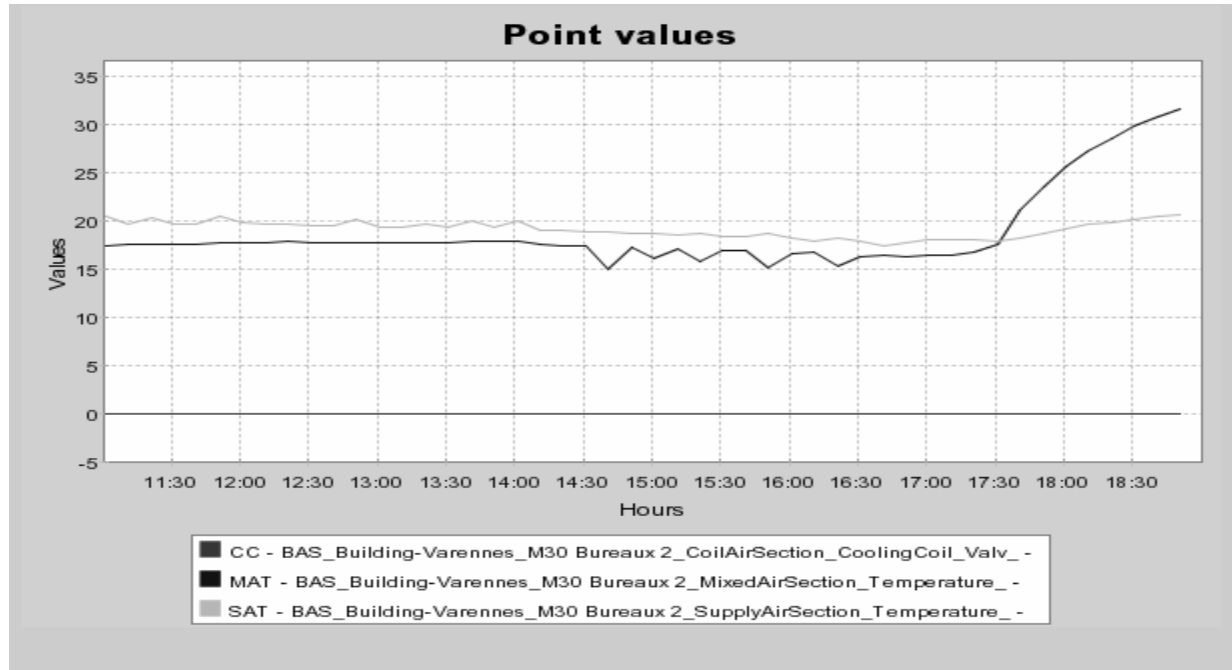
Suggested action: Verify algorithms used to function system

Impact:

☒ Rule 115: The humidifier control is on

Print

AHU Heating Valve Leak



AHU fault details

M30 Bureaux 2 - 2003-12-17 at 15h

Fault 24: Heating valve failure

Mode: Free Cooling

Suggested action: Verify damper, linkage, actuator, adjustment and leakage when closed

Impact: No control of heating coil, therefore no control of supply air temperature

☒ Rule 97: The supply air temperature is higher then the mixed air temperature the cooling coil valve is closed

General Visual Report Structure

Index Types
11 / 11 / 2003
☒ Statistic
Working hours
Devices
from 6 to 19
Apply

☐ Name
From 10 / 11 / 2003 To 10 / 11 / 2003

Name	Performance	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Aver...
M3 ... AF																
AHUMODE		1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.0	1.7...
AHUWS		0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.7...
BCAT		24.7	24.9	22.0	18.4	18.9	18.9	18.5	18.4	19.1	18.5	18.6	18.7	20.7	39.6	21....
CC		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CCA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHA		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
EAD		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HCV		0.0	0.0	0.0	10.4	13.1	12.9	12.0	11.2	12.8	12.0	12.0	12.7	13.8	13.9	9.7...
HUM		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAD		100...	100...	99.7	100...	100...	100...	100...	100...	100...	100...	100...	100...	100...	100...	99...
MAT		24.2	24.3	21.8	17.9	17.9	18.0	18.1	18.2	18.1	18.0	17.9	17.7	17.6	42.8	20....
OAD		0.0	0.0	100...	84.5	78.0	74.9	73.4	74.1	74.2	73.3	72.4	73.2	73.3	0.0	60....
OAH		69.2	66.0	62.3	57.2	51.2	48.3	48.0	46.5	52.3	81.7	80.1	85.4	87.9	89.6	66....
OAT		2.6	2.6	3.2	3.6	4.1	4.5	4.8	5.3	5.2	3.8	3.3	2.9	3.1	3.4	
RACO2		370...	374...	373...	385...	396...	404...	407...	410...	404...	402...	396...	390...	379...	371...	390...
RAT		24.9	25.1	23.3	21.4	21.5	21.4	21.4	21.5	21.3	21.6	21.5	21.5	21.4	22.4	22....
RF1V		0.0	0.0	31.0	28.5	26.6	26.9	26.6	26.3	25.7	26.3	26.4	26.5	26.1	0.0	21....
SACO2		75.1	74.8	75.0	79.8	89.1	97.1	98.0	94.9	88.7	88.8	87.5	85.3	76.4	77.9	84....
SAH		31.9	31.9	31.9	32.5	32.1	31.9	31.9	31.9	31.9	33.3	34.1	34.3	34.4	34.3	32....
SAT		25.1	25.1	23.2	20.0	20.3	20.4	20.3	20.0	20.5	20.2	20.1	20.3	20.8	21.7	21....
SF1V		0.0	0.0	0.0	50.1	50.7	51.7	52.5	53.0	52.8	53.4	53.6	53.7	53.0	0.0	37....

Legend

Normal
Low
High

Low alarm
High alarm
Off

Filters:

- ◆ Devices (one or all)
- ◆ Control points
- ◆ Indices
- ◆ Date
- ◆ Outside air temperature
- ◆ Outside air humidity
- ◆ Solar (if sensor is available)

Daily Room Device Performance Report

Graphic View

403 Commissioning report

Index Types

12 / 01 / 2004

...

Statistic

Working hours

Control: Temperature

Orientation:

Floor:

Devices

from 6

to 19

Apply

Name	orientation	Control	floor	AHU	Performance	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Aver...
403	C-S	Tem...	1	M3...	ZAT_SP	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
					FAULT	6.0	6.0	6.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	0.0	0.0	6.0	6.0	
					HCV															
					OAT	-15.5	-15.5	-15.4	-15.3	-14.9	-14.5	-13.9	-13.6	-13.1	-12.9	-12.9	-12.2	-13.3	-13.1	
					PI_AF	0.0	0.0	19.0	19.2	19.7	19.7	18.9	19.1	19.5	19.6	20.0	19.1	20.2	0.0	15...
					PI_AQ	0.0	0.0	-34...	61.2	76.0	81.4	78.5	82.3	98.3	119...	122...	121...	132...	0.0	44...
					PI_C															
					PI_H															
					PI_T	-13.0	-12.0	-18.4	-17.1	-11.3	-9.0	-7.3	-6.7	-6.9	-6.6	-6.9	-5.4	1.1	11.9	-7.6...
					RHCV															
					VAV_VOL	0.0	0.0	58.5	59.3	60.7	60.7	58.4	58.9	60.2	60.5	61.6	58.9	62.3	0.0	47...
					VAVD	100...	100...	100...	54.1	54.0	53.3	53.7	53.9	54.0	54.5	54.1	54.5	100...	100...	70...
					ZAT	17.6	17.8	18.2	21.3	22.4	22.9	23.2	23.4	23.3	23.4	23.3	23.7	23.6	22.7	21...
					ZAT_SP	20.0	20.0	21.6	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	23.3	20.0	23...
405		Tem...	1	M3...	FAULT	6.0	6.0	6.0	3.0	3.0	3.0	3.0	0.0	0.0	0.0	0.0	0.0	6.0	6.0	
					HCV															
					OAT	-15.5	-15.5	-15.4	-15.3	-14.9	-14.5	-13.9	-13.6	-13.1	-12.9	-12.9	-12.2	-13.3	-13.1	
					PI_AF	0.0	0.0	0.0	13.9	15.6	15.4	15.1	14.5	13.4	13.5	13.6	13.9	13.5	0.0	10...
					PI_AQ	0.0	0.0	0.0	51.7	70.5	74.4	73.5	73.2	79.1	95.7	97.9	103...	103...	0.0	58...
					PI_C															
					PI_H															
					PI_T	-0.2	0.0	-1.7	0.1	1.5	0.8	0.1	0.0	0.0	-0.2	0.0	0.0	0.9	-0.3	0.0...
					RHCV															
					VAV_VOL	0.0	0.0	0.0	50.0	56.3	55.4	54.6	52.4	48.4	48.7	49.1	50.1	48.6	0.0	36...
					VAVD	100...	100...	100...	49.0	49.0	47.3	50.0	49.0	48.5	49.1	48.6	48.6	100...	100...	67...
					ZAT	21.9	21.9	21.9	23.0	23.3	23.2	23.0	22.9	22.9	22.9	22.9	22.9	22.8	21.9	22...
					ZAT_SP	22.0	22.0	22.3	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	22.6	22.0	22...

Room Device optimisation report

(To reset AHU Supply air pressure setpoint)

[illegible]

Daily AHU Performance Report

Index Types		12 / 01 / 2004		Statistic		Working hours										
Devices		from 6		to 19												
Name	Performance	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Aver...
M3 Bureaux 1	AFA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	AHUMODE	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.0	1.7...
	AHUWS	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.7...
	CC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	EAD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	ENTH	32.3	32.3	29.8	28.3	29.9	31.4	32.3	33.1	33.7	34.4	34.3	34.0	34.2	36.4	32....
	HCV	0.0	0.0	0.0	27.7	31.8	31.0	26.6	21.6	17.4	16.1	16.0	16.3	17.3	0.0	15....
	HUM	0.0	0.0	0.0	100...	100...	98.3	100...	100...	100...	98.3	100...	100...	100...	0.0	71....
	MAD	100...	100...	100...	100...	100...	100...	100...	100...	100...	100...	100...	100...	100...	100...	100...
	MAT	22.6	22.6	22.7	13.0	13.5	14.0	14.8	15.4	15.6	15.9	15.7	15.8	16.0	20.1	17....
	OAF															
	OAT	-15.5	-15.5	-15.4	-15.3	-14.9	-14.5	-13.9	-13.6	-13.1	-12.9	-12.9	-12.2	-13.3	-13.1	
	RACO2	372...	374...	374...	398...	449...	491...	499...	491...	488...	497...	506...	499...	472...	441...	454...
	RAT	22.7	22.6	21.2	18.7	19.4	20.4	20.8	21.2	21.5	21.8	21.9	21.7	21.5	22.9	21....
	RF1	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.7...
	RF1V	0.0	0.0	28.8	24.6	23.4	29.5	37.1	40.0	40.2	40.5	40.5	40.5	38.3	0.0	27....
	SAH	29.2	29.2	30.2	38.4	39.3	41.9	41.2	42.1	42.9	43.5	44.5	43.8	44.6	41.9	39....
	SAT	23.3	23.4	21.6	18.3	19.0	19.1	19.4	19.4	19.2	19.2	18.8	19.0	18.8	20.3	19....
	SATSP	17.4	17.3	17.9	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	18.9	19.0	16.4	18....
	SF1	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.7...
	SF1V	0.0	0.0	40.6	40.8	40.6	44.4	49.1	51.1	52.4	53.2	52.1	51.3	49.5	0.0	37....

AHU Optimiser Report:

(To optimize heating supply water temperature)

Graphic View

403 Commissioning report

AHU 1107 Commissioning report

Index Types

12 / 01 / 2004

...

☐ Statistic

Working hours

Devices

from

6 ▼

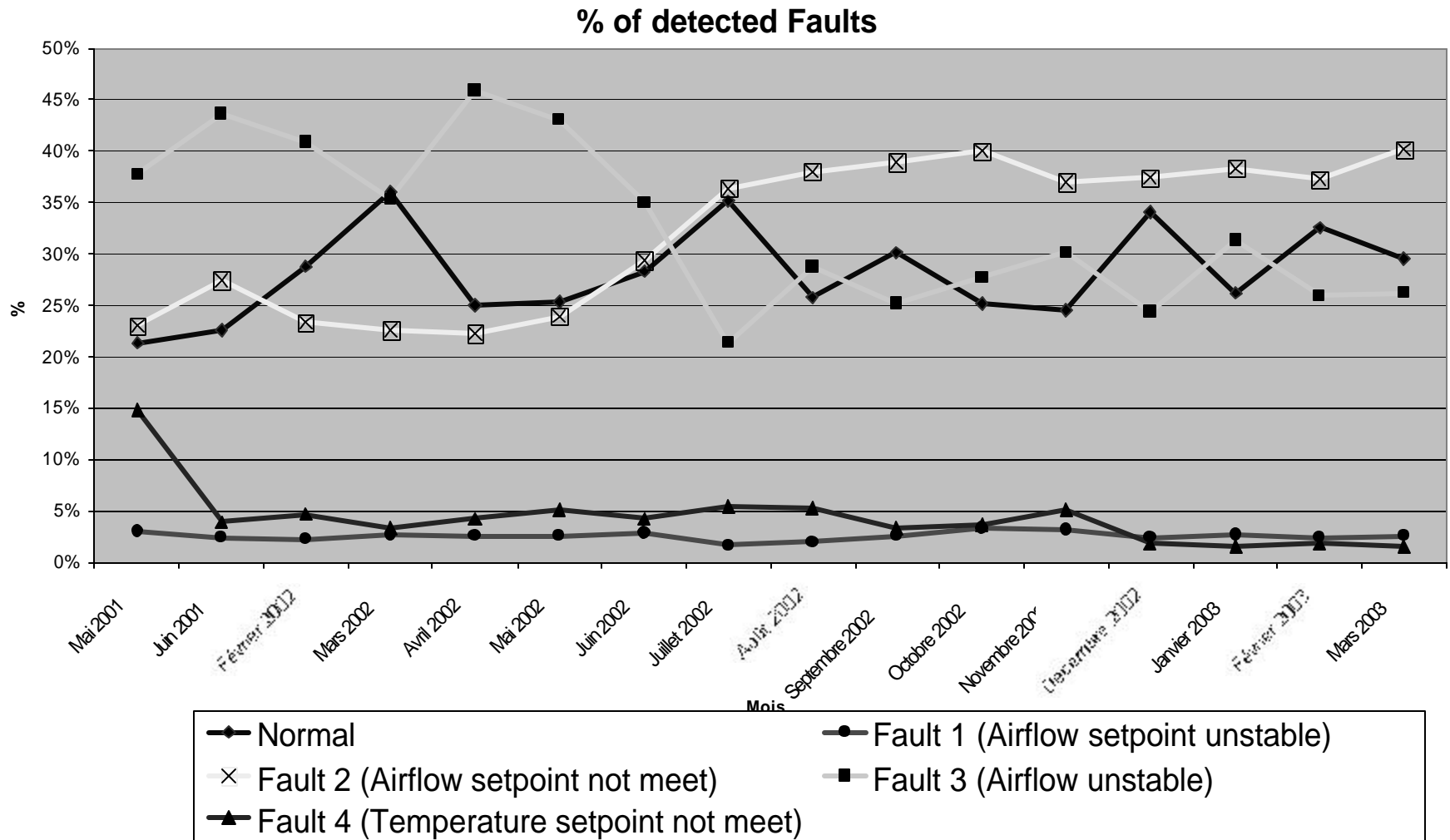
to

19 ▼

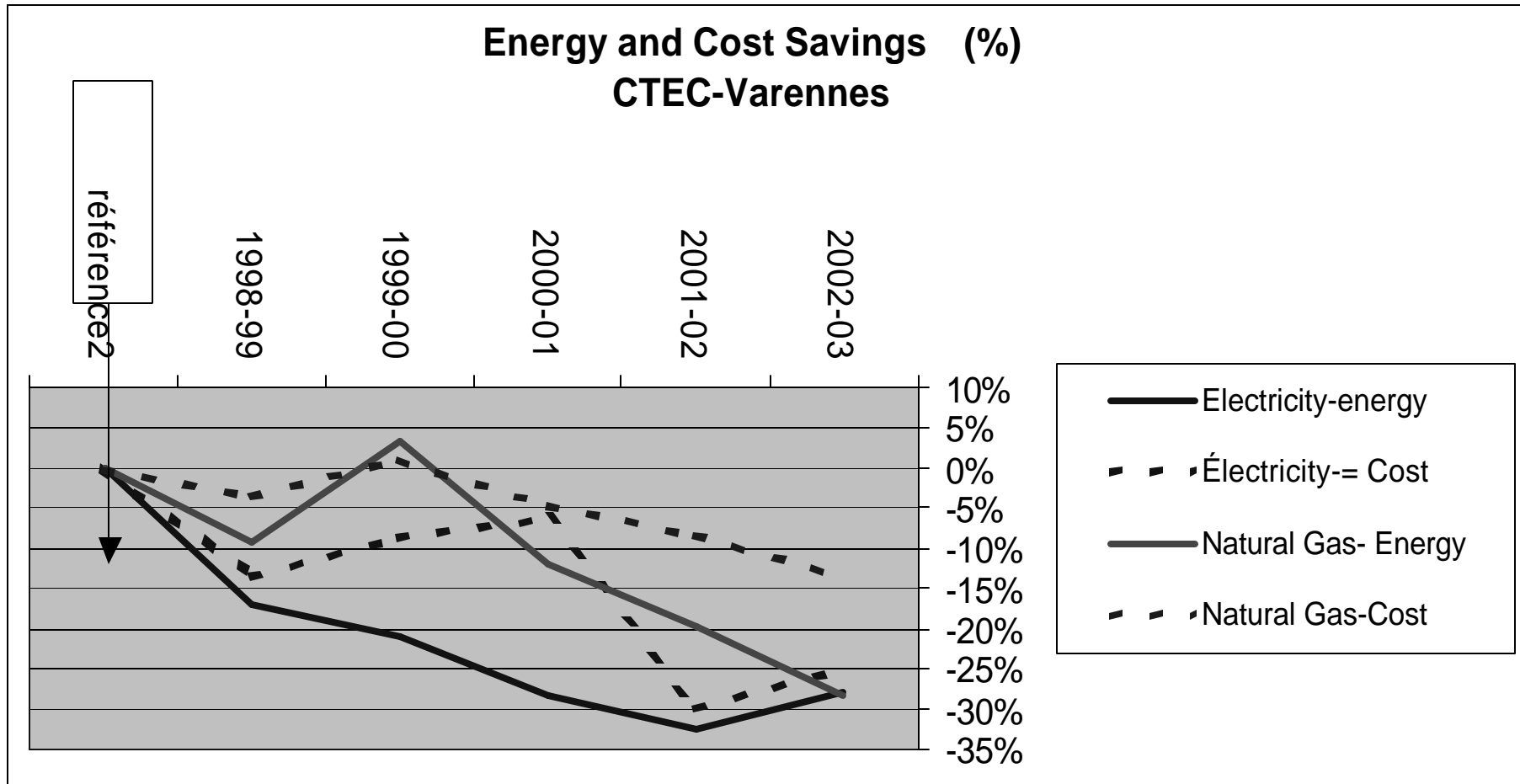
Name	Performance	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Aver...
M2 Laboratoires	HCV	37.3	37.3	36.3	36.7	32.1	33.5	32.6	33.7	30.8	30.2	33.1	36.1	33.0	33.0	34....
M3 Bureaux 1	HCV	0.0	0.0	0.0	27.7	31.8	31.0	26.6	21.6	17.4	16.1	16.0	16.3	17.3	0.0	15....
M30 Bureaux 2	HCV	0.0	0.0	0.0	54.1	31.6	27.7	25.4	18.9	0.0	14.9	21.9	22.3	23.1	0.0	17....
M4 Corridor	HCV	0.0	0.0	0.0	0.0	56.5	64.1	64.2	64.4	62.0	61.4	62.1	0.0	0.0	24.3	32....

VAV FDD Report

200 Dual Duct VAV Boxes



Energy and Cost savings



EMCS Assisted Commissioning Tool

- Monitors building control data
 - ◆ Could invoke sequence of tests
 - ◆ Normal operating data
- Performs advanced data analyses
- Detects faults, performs diagnosis and reports energy performance
- Generates detailed reports
- Implemented in stand-alone tools and/or embedded in EMCS



Next Steps

- Fine tuned expert rules in FDD-Component level
- Complete the FDD-System level
- Analysis of Demonstration project results

FDD Report For VAV Boxes

Graphic View

M30 Bureaux 2 FDD report

VAV Faults

AHU FDD report

System:

Floor:

Orientation:

Date: 02 / 07 / 2003

Details

Name	System	Floor	Orientati...		Averages for each hour of the day																							
					0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19				
405	M30 Bur...	1		T	22,7	22,7	22,6	22,5	22,5	22,3	22,2	21,2	21,1	22,6	24,0	23,3	22,9	22,7	22,7	22,5	22,3	22,4	23,6	24,0				
				SP	22,0	22,0	22,0	22,0	22,0	22,0	22,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	22,5	22,0	22,0	22,0				
1215	M3 Bure...	1	P-W	T	23,8	23,8	23,8	23,8	23,8	23,4	22,7	22,0	21,9	21,9	22,0	22,3	22,3	22,4	22,3	22,3	22,4	23,5	24,0					
				SP	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0				
1219	M3 Bure...	1	P-W	T	22,7	22,7	22,7	22,7	22,7	22,7	21,1	20,6	20,8	21,0	21,3	21,1	21,3	21,1	20,9	20,9	21,2	22,3	22,0					
				SP	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0				
1319	M3 Bure...	1	P-E	T	23,6	23,6	23,6	23,6	23,4	23,2	23,2	21,7	21,3	22,5	24,3	24,0	24,0	23,9	23,4	23,2	22,8	23,0	24,4					
				SP	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	23,4	23,0	23,0	23,0	23,0	23,0	23,0				
Lab1	M2 Labo...	1	C	T	23,5	23,5	23,5	23,5	23,5	23,4	23,4	23,2	22,4	22,4	22,3	22,2	22,2	22,1	22,2	22,2	22,3	22,3	22,7					
				SP	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5				
Lab6	M2 Labo...	1	C	T	25,4	25,5	25,5	25,5	25,5	25,5	25,5	25,4	24,6	24,6	24,5	24,2	24,1	24,0	24,0	23,9	23,9	23,9	23,9					
				SP	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0				
Lab2	M2 Labo...	1	C	T	24,0	24,1	24,1	24,1	24,1	24,1	24,1	24,0	23,3	23,0	22,9	22,9	22,7	22,7	22,6	22,6	22,6	23,1	23,0					
				SP	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0				
Lab3	M2 Labo...	1	C	T	23,8	23,8	23,8	23,8	23,8	23,8	23,8	23,7	23,0	22,9	22,8	22,6	22,5	22,5	22,6	22,7	22,7	23,0	23,0					
				SP	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0				

Fault legend

System not running

Temp. Setpoint not satisfied

Airflow unstable

Airflow Setpoint not satisfied

Airflow Setpoint unstable

Normal